Macro-Assembly of the ATLAS Barrel SCT

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Like all LHC detector construction projects the assembly of the barrel section of the ATLAS SemiConductor Tracker (SCT) is well advanced.

In particular the mounting of the 2112 Silicon strip detectors onto the four cylindrical barrel support structures (ATLAS SCT barrels 3-6) is now taking place at Oxford University. This part of the barrel SCT assembly is referred to as macro-assembly.

The barrel SCT Silicon detectors with their on-detector binary read-out electronics are assembled at four different construction site clusters all over the world from where they are shipped to Oxford, where they are reception tested and then stored until thy are mounted onto the support structure. Each detector consists of two single-sided layers glued back-to-back with a stereo-angle of 2.5 mrad and has a surface area of about 14×7 cm^2.

The carbon-fibre support cylinders in the meantime are equipped with all services. These consist of the Kapton Flex circuits to provide electrical power to the on-detector electronics, the optical fibres and opto-couplers needed for data transfer to configure and read out the detectors, cooling pipes to remove heat generated by the on-detector electronics, optical components of the Frequency Scanning Interferometry (FSI) alignment system and various sensors to provide data to the ATLAS Detector Control System (DCS) to monitor slow control parameters. All these services are mounted on the support cylinders before the Silicon detectors are added, thus limiting the clearances available to the modules during the approach to their final position to about 1 mm in the most critical locations. Such clearances were deemed insufficient for human operation and this part of the assembly is performed by a robot. The robot also controls the torque of the fixing screws. Other procedures, like electrical or thermal connections to the services are performed by human operators with specially developed tools.

Once the assembly is well established the procedures required to completely mount and connect one module will take about 45 minutes and we plan to mount 96 modules per week in two shifts.

At regular intervals during the assembly and after the completion of each barrel the performance of the assembled system is verified. For this a subset of the final ATLAS infrastructure has been set up at Oxford University. In fact, this setup for the first time combines all the system components for powering, cooling, controlling and reading out the ATLAS SCT in their final or close-to-final versions. In particular this system will comprise 18 power supply crates (as compared to 44 for the final ATLAS barrel SCT), one VME crate with digital read-out (ROD) cards and an evaporative cooling plant with a capacity to remove 16 kW at -15°C using C_3F_8 or at 10°C using C_4F_{10} as coolant.

After a final test at close-to-final operating conditions each completed barrel will then be shipped individually to CERN for the final integration of the four barrels into the ATLAS SCT and inner detector. To achieve such operating conditions the assembly at Oxford University takes place in a thermally insulated room, which can be cooled to ATLAS SCT operating temperatures (~ -15°C), while keeping the humidity at levels which prevent condensation.